

CONTAGION AND INFECTION

IN

RELATION TO EPIDEMIC DISEASES.

BY

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"How many controversies have occupied the mind for ages, and have filled most innumerable volumes, which have essentially turned upon the definition of a word."—Dr BOSTOCK'S *History of Medicine*.

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NEARLY three years have now passed since this Society published in the form of a circular a short, though comprehensive, statement of the objects for which the Society was instituted. At the close of the second paragraph under the heading, "Objects of the Society," is the following sentence:—"To point out those methods of investigation by which the misleading influence of false or deficient evidence may be best avoided."

It is in the furtherance of this object that the following observations have been put together for consideration and discussion by the members.

Starting with a common purpose in any investigation it is necessary for the successful pursuit of our objects, that the elements of our subject should be reduced to their most concise definition, and that the terms and expressions in ordinary use should, by general assent, be understood in a given determinate sense.

"Definition of words," said Sydney Smith, "has been commonly called a mere exercise of grammarians; but when we come to consider the innumerable murders, proscriptions, massacres, and tortures which men have inflicted on each other from mistaking the meaning of words, the exercise of definition certainly begins to assume a rather more dignified aspect;" indeed it is wonderful how much the science of medicine has been retarded by lengthened controversies and voluminous writings, having their origin in misinterpretations and vague expressions. If any branch of medical literature is particularly beset with the evils to which I have referred, it is that termed Epidemiology. Take the words contagion and

infection in relation to epidemic diseases, the result will be found to exhibit such a discrepancy of ideas and conclusions arising from want of an uniform interpretation of their meaning, as to make the whole subject appear rather a labyrinth of words than an inquiry of scientific importance.¹

In proof of these statements I shall select three authorities as an illustration. Dr Copland, in his Dictionary of Practical Medicine, says, "I use the word infection in its generic acceptation, employing it according to the meaning attached to it by Virgil, Ovid, Pliny, and other classical writers of antiquity, and many modern authors, and applying it to whatever may affect, so as ultimately to taint, pollute, or corrupt the body." Here it is clear the *whatever* implies some agent which may taint, pollute, or corrupt; but in the next passage we find the word infection having a different signification, thus: "I use also the word contagion in the sense imposed on it by Virgil, Columella, Pliny, and Curtius, as an infection by immediate or mediate contact—as a pollution by the touch." In this passage the word infection is used to define an effect, viz., pollution.

A more recent writer, in the second report on Quarantine, issued by the Board of Health, puts forward the following explanation of the words contagion and infection. "I mean by contagion the power of communicating disease from the person of an individual labouring under it to that of another, whether by contact or other means. By infection I would be understood to mean a principle which produces the disease, depending altogether upon local causes, and having no relation to emanations from persons labouring under the disease, or from the bodies of those who have died of it."²

In the first Report on Quarantine, contagion is used in a different sense again, thus:—"If it can be proved that quarantine, instead of affording any protection against contagion, absolutely fosters it," etc. In another part is the following: "By such substitution (that is sanitary for quarantine regulations) the most effectual security which the present state of knowledge affords, would be taken against the importation of *foreign* contagion, the maintenance of infection, and the origin and spread of epidemic diseases."

¹ "Contagion is carefully to be distinguished from infection. The distinction is clear and broad. From not regarding it, medical men have fallen into the grossest errors, both in their so-called facts and in their reasonings. It is of great importance, theoretically and practically, that this distinction should be understood; it is a subject in which, on many accounts, the public has a deep interest."—*Penny Cyclopædia, Art. Contagion.*

"Contagion, the matter of, a poison. The term contagion is also in common use, to denote the actual propagation of diseases of a specific nature from person to person."—*Ibid.*

² Edinburgh Review, July 1853.—P. 193. Properly speaking, contagion implies actual contact, being quite independent of atmospheric agency; while the influence of infection, as far at least as regards the diffusion of exhalations from the sick—in contradistinction to the wide spread morbid action of a malarious atmosphere, is confined within extremely narrow limits. See First Report on Quarantine also.

Divesting the above quotations of their general purport, and applying the specific meanings attached to the words Contagion¹ and Infection by the respective authors, they stand thus:—

According to Dr Copland—

Infection signifies	Whatever may taint, etc.
Contagion —	An infection—a pollution.

According to Dr Gilkrest—

Infection signifies	{ The principle which contaminates, <i>but not emanations from persons.</i>
Contagion —	
	The power of contaminating.

According to the General Board of Health—

Infection signifies	Something which may be maintained.
Contagion —	Something which may be imported and fostered.

It would be easy to adduce many more authorities—further incongruities; but I forbear citing them. My object is simply to show that those whose views should be the most precise, and whose definitions the most clear, have added to, rather than lessened, the difficulties they have laboured to overcome. But to leave definition for the present, let me quote a passage from the first “Report on Quarantine” by the Board of Health, to show how much ambiguity may be contained in one paragraph. It is this:—“There is one point of view in which it may be proper, and even necessary, to consider the question of contagion with relation to that of quarantine. Assuming the existence of contagion, if it can be proved that quarantine, instead of affording any protection against contagion, absolutely fosters it, the stronger the proof of contagion the more decisive the argument presented by it against quarantine; and it will be shown hereafter that this is the true and the only relation in which contagion stands to this question.” Here, in less than ten lines of the Report, the word contagion occurs five times, and its relative pronoun twice; thus the signification of the word enters seven times into the general import of the paragraph. The simple reading of the quotation I take to be this:—“The doctrine of contagion has no necessary connection with quarantine. But the stronger the proof that there are communicable diseases, and that they are more particularly maintained and fostered by quarantine regulations, the more decisive the argument against quarantine.”² I may, however, be mistaken in my conjecture, for official language has a license for wide interpretation which is not accorded to ordinary diction. In another

¹ M. Rouchoux applies the term contagion to those agents which are capable of multiplying by reason of an inherent organism, and infection to those agents which require for their development certain additional conditions, such as contaminated or impure air, etc.

² Cyclopædia of Practical Medicine, Art. “Contagion.” By this term is meant the propagation of disease from one individual to another, though it is sometimes used, both in speaking and writing, to denote the matter by which the propagation is effected.

part of the same Report I find this expression, "Contagion is a term applicable to a different set of circumstances;" and a little farther on, "strictly, contagion, as the word implies, is capable of being communicated only by actual contact;"¹ so that in reality we are to understand "that contagion is a set of circumstances capable of being communicated only by actual contact." It is very evident that the confusion surrounding this subject arises from the use of the word contagion in a double sense, to signify, indeed, both a cause and an effect. It is applicable to the agent, the poison, the exciting cause of disease, and to the mode by which diseases may be propagated. To this circumstance chiefly, I attribute the interminable disputes which have been connected with cholera, yellow fever, and plague; and how can disputes be other than interminable when the terms and expressions that enter into the subject of controversy are destitute of the requisite of primary importance, viz., an accurate definition?

The word infection is also used in a double sense to imply both cause and effect, as may be seen in the following passages. I quote from the Quarantine Reports, because they are recent and popular documents. After alluding to yellow fever being communicated to the attendants on the sick, and the failure of large wards in preventing the continuance of this misfortune, the advantage of removing the sick into the open air is mentioned in the following words:—"Here a manifest improvement occurred; the disease became more manageable, fewer persons were attacked, and the attendants were less liable to infection."² In this instance the word infection signifies an effect, viz., "contamination by the emanations from the sick." In the following instance it is used as the cause:—"The persons about them were seized, and very exactly, in the ratio of their exposure to the infection, the nurses preceding the clerks,"³ etc.

Having pointed out the fact that cause and effect are at present, by the peculiarities of our language, necessarily confounded under the same expressions and terms, I proceed with some hesitation to suggest the introduction of a word from the Latin language as a means of obviating confusion, and to afford more precision to the subject of epidemiology. As some justification for the following attempt at simplifying our nomenclature, I may mention that Sydenham found it necessary to use a word to convey his idea of the contaminating agent of plague. He said, "Besides the constitution of the air, as a more general cause, there must be another previous circumstance to produce the plague, viz., the receiving the *effluvia* or *seminum* from an infected person, either immediately by contact or mediately by pestilential matter conveyed from some other place." Dr Robert Williams, in our own time, has designated the agents of disease as morbid poisons, Dr Copland as infectious agents; but the

¹ First Quarantine Report, pp. 46 and 47.

² See First Quarantine Report, p. 35.

³ First Quarantine Report, p. 50.

more general term in common use is virus. It is usually applied to the poison of small-pox, cow-pox, and syphilis. We do not hear, however, of the virus of scarlatina, measles, or whooping-cough, of yellow fever, or cholera; but all men are agreed as to the existence of what Sydenham would call the seminum of epidemic, endemic, and infectious diseases. It is upon this circumstance of uniform agreement on one point that I base my opinion of the necessity for the adoption of some *generic term* to include all that is meant by "seminum," "morbid poisons," "infectious agents," "virus," "miasma," etc.

All the words we have in use derive their origin from the Greek or Latin language. Contagion, from *contagio*, signifies contamination; pollution, the act of contaminating or polluting. All words, as far as I know, ending in *ion*, imply a process, an action, or an effect, as fermentation, which conveys the idea of a process, excision, the action of cutting off, confusion, the effect of disturbance, or misplacement of things previously in order. But it is also manifest that a word ending in *ion* may, according to the general tenor of the sentence in which it occurs, be made to signify either a process, an action, or an effect; contamination may thus mean the effect produced, the action going on, or the process to be gone through. In no way, however, can we reasonably apply the same word to signify the *cause* of such process, action, or effect. The word *contagion* should therefore be used in that sense only which is indicated by its terminus. *Infection*, from *infectio*,¹ is similar in its signification to contagion, but does not necessarily include tainting by touch. It is, however, less limited than its congener—that is to say, to infect is to dye, to stain, to poison, and anything which is dyed, stained, or poisoned, may be said to be infected with the dye or poison, so infection would here mean the process of infecting, the act of infecting, or the contaminating effect of a poison. We have at present no generic term to indicate the poisonous agents of disease. It is unquestionably desirable that our vocabulary should contain a word to denote what we mean by an agent of disease, and especially such a one as would admit the affix of a specific term to it with euphony. At the same time, it would be an advantage if the word could be an Anglicised Latin word, for then no difficulties could arise from mistranslation.

The word *contagium* appears to me to supply these desiderata, for the following reasons:—

1st, It is synonymous with *miasma*, which, in its primary sense, is "anything which pollutes," or, as Dr Adam Littleton defined it,²

¹ *Inficio*, to poison, to infect, to corrupt.

² Contagio, *συνάφεια* Pollution.

Infectio, " "

Contagium,..... *μιασμα* } Anything which pollutes or defiles.
μολυσμος

"*quia quem tetigerit polluit.*" Now, if this expresses accurately what is meant by contagium, it is particularly applicable to "infectious agents," and no word could better or more forcibly convey to the mind the properties of those unseen forms of matter which contaminate and corrupt our bodies. Contagium was chiefly used, I believe, by the poets. It occurs in the following lines of Virgil and Horace in the plural number. Thus—

"Nec mala vicini pecoris contagia lædent."—*Virgil's Eclo.*, i. 51.

"Contimio culpam ferro compesce, priusquam.

"Dira per incautum serpent contagia vulgus."—*Georg.* iii. 468.

"Nulla nocent pecori contagia."—*Horace, Ode xvi.* 61.

These passages have been translated as if the word were used in the singular number, and contagion made to stand for contagia; but if we take contagia as miasmata, the reading is not impaired.

2d, Contagium may be employed generically with a specific affix, in a manner not to be misunderstood. Thus we should have contagium variolæ, contagium rubeolæ, contagium scarlatinæ, etc.

3d, Contagium and contagia may be Anglicised as effluvium and effluvia have been. I think, however, the former adaptation, if made, would have more show of reason in it than the latter. Contagium would then everywhere mean the contaminating agent, and plurally, agents or elements of disease. We should then have means of making a clear distinction between cause and effect, and run no risk of confounding them as we now find so commonly done, by the appropriation of contagion and infection for both purposes.

The term "communicable diseases," used by Dr Snow to avoid the word contagious, is, for several reasons, to be preferred; because it includes all modes by which diseases may be propagated, but it does not put aside the necessity for the distinction to be borne in mind, that all diseases are not propagated in the same manner. There are three modes in which disease may be communicated, namely:—1st, By inoculation, that is, by abrasion of the skin, and deposit of the virus in or upon the wound, as in small-pox, measles, scarlatina, hydrophobia. 2d, By application or deposit of the contaminating matter to the skin or mucous membrane, without abrasion of the surface, as in favus, aphtha, and gonorrhœa. 3d, By ingestion, that is, with the air into the lungs, or with the food or drink into the stomach; by inhalation, as in whooping-cough and typhus; by aliments, as in dysentery, and probably some fevers.¹

The analogous modes of vegetable propagation are—1st, The grafting or budding implied by the word inoculation. 2d, Sowing the seed by depositing it on the surface. And 3d, The ordinary accidental diffusion of vegetation by means of the air, etc.

¹ Dr Darwin did not admit that contagion affects the system in any other manner than through the medium of the intestinal canal. This view, as far as regards cholera, typhus, and some other diseases, has been recently advocated by Dr Snow.

Now, if we limit the term contagious to all such diseases as are propagated by the first and second modes, and infectious to all those which are propagated by the third mode, we shall find three divisions again, viz., diseases which are *contagious* only, or communicable but by the touch; diseases which are *infectious* only, such as are propagated by the third mode; and diseases which are both contagious and infectious,—that is, such as are propagated according to the first and third, or second and third modes. I must not, however, pursue the subject of classification, as my present purpose is to consider contagion and infection in relation to epidemic diseases. With regard to the propagation of epidemic diseases, there are three things for consideration. 1st, The poison; 2d, the recipient; and 3d, atmospheric and telluric phenomena.

Of the poison, or exciting cause of epidemic disease, it must be in a potential condition capable of development, and of inducing in living beings those morbid changes of function and structure peculiar to its kind.

Of the recipient, the individual must furnish, either by its fluids or its solids, a condition adapted for the development and specific operation of the poison-force, if I may use the expression; that is, the seed must fall on a congenial soil.

Of the atmosphere or the earth, there must be a peculiar condition, of one or both, associated with the two previous requisites over an extended area, for the full manifestation of a virulent pestilence.

Any modification of one or all of these circumstances or conditions must necessarily influence the result, and nothing short of bringing all these elements under some comprehensive laws can avail in unravelling the mysteries of epidemic disease.

What are the facts in proof of these statements? may be very fairly asked. I answer, Every recent document, whether from commissions, boards, or individuals, tends to show this great fact, that all diseases which merit the name of pestilences, are communicable from one person to another; that where they have not appeared to be so, it has been under circumstances which have modified the results, not altered the facts.

Thanks to Jenner, small-pox does not now assume among us the character of a pestilence; but the discovery of vaccination did not change the disease, the virus is as potent, the agent as subtle, and the laws of its being as unchanged and unchangeable, as if vaccination had never been known.¹

The occasional prevalence of small-pox among us, indicates that there is but one condition wanting for its development as a pestilence, that is, the state of the recipient.

¹ Quantity and intensity of morbid poisons. As to *quantity*, the poisons have been diluted, but their specific effects have been as strongly marked. As to *intensity*, the milder forms of disease, from which it would be imagined a poison of feeble intensity should be eliminated, are no security against a virulent attack in those contaminated under such circumstances.

The epidemic foci so frequently mentioned in the French Report of 1844, and which are, I may say, generally considered to be conditions dependent on local and atmospheric causes, do not appear to bear the importance attached to them, for the expressions "*foci of infection*" and *epidemic foci*, according to the conclusions of the commissioners, must be transmutable terms. Thus they say—1st, Plague patients, by vitiating the air of places wherein they are confined, may *create foci* of pestilential infection that are capable of transmitting the disease." 2d, "Foci of pestilential infection may persist in a place after the removal of plague patients from it." 3d, "Foci of pestilential infection once formed in a vessel, by the presence of one or more plague patients on board, may be transported to great distances." These are said to be corollaries to the following conclusion:—"The transmission of the plague by pestilential miasms is a proved fact;" and this is in answer to the question, Can the plague be transmitted by pestilential miasms beyond or away from epidemic foci? Now I am at a loss to discover what distinction is to be drawn between a focus of infection and an epidemic focus. If pestilential foci can be transmitted to great distances, and cause, in distant places from the original site of a disease, the outbreak of a pestilence, the focus of disease is as much an epidemic focus as a focus of infection.

It is, in fact, the use of these ambiguous words which so complicates our inquiries. In the Official Report on the Cholera at Ham-burgh, we read—"The attacks in the hospital resulted from the influence of the epidemic, not in consequence of contagion." How are all these epidemic foci and influences to stand in regard to the prevalence of cholera at East Farleigh, in Kent, in the year 1834; for then, though cholera did not elsewhere prevail, thirty-four persons, hop-pickers, died of the disease. How many were attacked we are not told, but taking the ordinary rate of mortality, it is fair to presume there must have been about 100 cases. Now it is rather extraordinary, in juxtaposition to the above, that in the fatal year 1849, this favourite spot of the epidemic force or influence yielded no cases of cholera until the 12th September, when it was on the decline in the country. Then the history of its commencement is equally singular and instructive. Mr Grainger says—"The first case was that of a man who had arrived the evening before, and who had been suffering from diarrhoea the day previously. The disease rapidly extended, so that in three or four days seventy or eighty persons were ill." Of the number attacked with developed cholera, viz., ninety-seven, there died forty-six. Thus it will be seen that, when the so-called "epidemic influence or atmosphere was covering this island as with a cloud," the deaths among the East Farleigh hop-pickers was only increased by about one-fourth compared with the previous occasion, when no "epidemic atmosphere" prevailed.

Then, again, East Farleigh is only four miles from Maidstone.

This latter place yielded its first victim to cholera on the 1st August, while the former, though at so short a distance from Maidstone, did not furnish a case till six weeks afterwards; and that case clearly points to the well known fact, that a single infected individual may be the source of a subsequent extensive contamination. What part the fabled "epidemic atmosphere" plays in these proceedings, will ever, I believe, be *in nubibus*. That seasons and localities, accompanied with intricate cyclical phenomena, both atmospheric and telluric, have great influence on the development and spread of communicable diseases, all are constrained to admit. But over these we have no control. It is to the poison, and the condition of the recipients of the elements of disease, that our chief efforts must be directed. The draining and cultivation of land have removed the causes by which the poison of intermittent fever was sustained. The practice of vaccination has for its basis the substitution of a mild for a malignant poison: all prophylactic measures and disinfecting agents have regard to the poison and the recipient. To the study of these alone, and the practical applications flowing therefrom, are we indebted for the mitigation of pestilential and infectious diseases.¹ Why, then, should we, with the facts of two centuries staring us in the face, revert to the old dogma of hidden forces, or supernatural agencies. I look upon the terms, "*Epidemic Atmosphere, Influence, and Force*," as most dangerous and destructive expressions. They divert the mind from the course of inductive and legitimate investigation; they suggest elements of doubt, that render mysterious what would otherwise be clear, and throw us back on the past, rather than lead us on into the future.

We are safer with the language of Sydenham, and his epidemic *constitutions*, when he says, "By a secret tendency of nature, some diseases follow the seasons of the year, with as much certainty as some birds and plants." "Nature observes the same uniform method in producing and bringing diseases to a height or a crisis, as she does in the production or growth of plants and animals." Again,

¹ *Puerperal Miasmata*.—Dr Busch, Director of the Berlin Midwifery Clinique, after remarking upon the great difficulty there exists in keeping a lying-in hospital free from puerperal fever, relates the result of an experiment he tried at Berlin. During *February and March 1851*, after an epidemic of influenza, one of puerperal fever prevailed extensively amidst all classes at Berlin, the hospital suffering severely during *the latter month*. It was evacuated, thoroughly cleaned and ventilated *for six weeks*, and reopened in May, —when, however, *every woman admitted* became affected soon after delivery. Reflecting upon the influence of hot air in destroying contagious fomites, Dr Busch had stoves introduced into the wards, and all the bedding utensils, etc., were exposed to a temperature of from 150° to 170° Fahrenheit during two days. On patients being readmitted, no more cases occurred, although the disease still prevailed in Berlin. In *December 1851*, four women were seized with the disease in one apartment, one of them dying. A heat of 170° Fahrenheit was resorted to, and no extension of the epidemic occurred. To the time of writing, *June 1852*, no recurrence had taken place.—*Med. Chir. Rev.*, April 1853, p. 574.

in speaking of the plague,—“ This disease has its times of increase and declension like other kinds of natural things. It begins between spring and summer. As the year advances it spreads, and as that declines it abates.” Over times, seasons, and cycles of cosmical changes, our utmost exertions to exercise any influence will avail us nothing. Whether a disease be contagious, or infectious, or “*contagio-infectious*,” or simply endemic or incommunicable, as some tropical and intermittent fevers are said to be in all cases, the miasm, and those subject to its influence, demand our first consideration. Our indigenous fevers, which still pass under one name in the reports of the Registrar-general as typhus, have been clearly shown to depend on three specific poisons; and it is not improbable that time and labour may as distinctly trace the specific characters of the tropical fevers, if the same opportunities occur to one equal in zeal and ability to Dr William Jenner. The whole intricacy surrounding the subject of tropical fevers, appears to me to arise in a great measure from too narrow a view of the sources of contamination. In what proportion of cases can we trace typhus or small-pox to their source? Many instances have come under my own knowledge, in which it was impossible to discover how these diseases were contracted. If these cases were multiplied by the observations of medical men throughout the country, and recorded, they might be taken as evidence to show that small-pox and typhus are not communicable diseases. But we have

“ Confirmation strong, as proofs of holy writ,”

that typhus is a communicable disease, the history of the epidemic fever of Ireland of 1817, 1818, and 1819, supplies unequivocal testimony on this head, the evidence furnished by the medical officers of the gaols gives undoubted proof that the propagation of the disease was due to unrestricted intercourse of the sick or infected with the healthy, and that in the few instances where restraint on communication was adopted it was attended with the happiest results. It has been attempted to exalt unduly, as I think, the importance of the so-called predisposing causes of epidemics, putrescent food, foul water, unwholesome and over-crowded habitations, all kinds of filth and abominations; excesses and privations must, doubtless, tend to lessen the powers of resistance to all disease-inducing agents, but there is this remarkable fact to be observed, it is not in those whose bodies, preoccupied by disease, are rapidly yielding to the disintegrating forces, that epidemic diseases develop themselves by preference; it is not among those who are already bearing the stamp of death upon their forms and visages that epidemics make their inroads; but it is among those chiefly who are disobedient to the natural laws. Dr Sutherland has compressed within a very small compass, the whole subject of predisposing causes of epidemic disease, in the 1st section of his Report on Cholera. In page 8 he enunciates a doctrine which certainly claims attention; but this elementary disintegrating hypothe-

sis, if true, should include in its range an explanation of the epidemic visitations of both animals and plants. Here it appears to fail altogether; we are obliged then to revert to the exciting agents of these diseases, and take a wider view of contagion and infection.

The great impediment to the settlement of the contagion controversy is, that both parties in the argument endeavour to make their preconceived notions of a contagious disease square to the one involved in the discussion; thus the non-contagionist looks for the same evidence of the contagiousness and infectiousness of yellow fever and cholera as of small-pox and hooping-cough. The contagionist, on the other hand, considers it necessary to adduce such facts only as are in accordance with the received *contagion theory*, and finding those he is able to bring not sufficiently conclusive, he lays bare his deficiencies by overstraining a weak point. To give instances which show the error of this mode of argument, I will cite two authentic cases in which contagious diseases made their appearance in a manner totally inexplicable. *The first*, a case of small-pox, occurred to a lady "who lived in an out-of-the-way place, no small-pox having been within a hundred miles of it, and no intercourse with strangers to the village, or with persons from a distance, having happened for months. The nature of her case was not understood by her attendants until it was found that she had become a focus of small pox contagion, which spread freely among the non-vaccinated." The editor of the Journal in which this case is inserted refers to two¹ "which recently occurred in the Eastern Penitentiary of Pennsylvania, in which the separate system is enforced. In one of the cases, the convict had been incarcerated for two years, and in the other for six."

The *second case* is that of a girl "aged 14 years, who was seized with influenza. She complained of pain in each arm at the spots where, when an infant, she had been vaccinated, and, in fact, in these localities vaccine vesicles now became perfectly developed. An elder sister was re-vaccinated with the lymph hence obtained, beautiful vesicles formed and ran a normal course."²

Now, here are instances of contagious diseases making their appearance under circumstances quite incompatible with the generally received doctrines of contagion, the most rigid scrutiny of which fails to trace the source of contamination.

From such facts *some* would argue for the spontaneous origin of these diseases, *others* would say they are anomalous cases, from which no conclusions can be drawn; but the more obvious and rational course to pursue would be that of inquiry. It is by isolated facts, such as these, aided by analogical reasoning, that we reach the knowledge of causes. To solve the problem of disease we proceed from effects to causes, and it is by experiments founded either on

¹ Case of twins in utero. Mother infected. One child infected—the other intact.

² Med. Chir. Rev.

conjecture or hypothesis that our work is to be accomplished. Unfortunately, however, experiments on disease are nothing less than traffic with death and misery, and are not likely to be entered on. To me those we read of on Syphilis are revolting in the extreme. We have, nevertheless, daily instances of what may be termed *natural experiments*, as incidents of disease, which only require interpretation, and it is upon these chiefly that our knowledge is founded. The identity of lightning and electricity, though associated by a heap of analogies, was not proved till Franklin, in the year 1752, drew silently into a bottle the artillery of heaven. He interpreted the experiments made by nature on a large scale, and at length by his crowning experiment he converted an hypothesis into a great and indisputable fact.

The exciting agents of epidemic and infectious diseases are not amenable to physical experiment, except in a few instances; but where experimental proof has been obtained of the existence of such agents, they have, as far as I know, been found to consist of organized matter endowed with vital properties. Beyond these few instances, epidemiology, like medicine generally, is a science of fact and observation, of evidence and experience. On a previous occasion, when I had the honour of reading a paper before this Society, I endeavoured to show that the agents of disease came under the dominion of the same laws as all things that live. It is, indeed, to the dispersion and diffusion of cell-life that we must look for a solution of the mysteries of contagion and infection. Every seed has not its pappus or its hairs to wing it to its destination, nor does every plant prepare its own pollen for the fertilization of the new germ; but other means are provided by nature for the dispersion of seeds and the impregnation of the plant. The Baron Humboldt, in his "Aspects of Nature," thus alludes to this fact:—"Even the fertilizing dust or pollen from the anthers of the male flowers, in species in which the sexes are separated, is carried over land by winds and by the agency of winged insects to the solitary female plant on other shores. Thus, wherever the glance of the inquirer into nature penetrates, he sees the continual dissemination of life either fully formed or in the germ." In like manner must we regard the dissemination of poison germs: their mode of transmission is not uniform. We cannot expect that all communicable diseases should be proved to be so by the same data which are found to apply in a single instance. Indeed, if we take the hypothesis of cell-life as the elementary basis of the morbid poisons, all the facts, phenomena, and apparent anomalies of infectious and contagious diseases become associated into an intelligible system. Moreover, it furnishes us with "*a guiding idea*," which is so essential to the successful prosecution of investigations of this kind.

To illustrate fully the working out of this hypothesis would lead me far beyond the limits of my present intention.

As a sanitary question, uniformity of doctrine on contagion and

infection cannot be too much encouraged. Whatever may be said to the contrary, legislation on quarantine and the means of arresting communicable diseases must necessarily be either imperfect or impossible, unless more decided and correct views are established. It has been said that the disputed point of contagion should be placed entirely out of view in this discussion, and the whole question should be argued on the broad ground whether or not quarantine is a public security.

These are certainly erroneous notions, and show clearly enough the unsettled state of the whole science of this subject. We have even recently been told, that it is possible typhus, scarlatina, influenza, plague, yellow fever, and cholera, may derive their origin all from one common agent, though we are not favoured with the individual names of those who entertain this opinion.¹ But when we know that those islands and countries which have limited intercourse with other people have frequently remained for many years without a single case of measles or small-pox, and that when these diseases have made their appearance, they have been traced almost uniformly to undoubted importation, and moreover, that they then spread like pestilences, who can for a moment question, not only the general utility of some form of quarantine, as well as a more intimate knowledge of the laws which govern the diffusion of disease. That quarantine laws have in many instances failed in accomplishing their object is not a matter for marvel to any person who has but a slight acquaintance with their practical application, or the manner in which they have been carried out. Again, how can laws which have been framed in part upon what are now obsolete ideas be adapted to the present time? But because the laws are imperfect, and the fulness of their object unattainable, is no reason for their abolition; indeed, it would be as rational to make a bonfire of the criminal laws because they have failed to suppress or exterminate crime. If the necessities of this commercial country demand unlimited freedom of intercourse with foreign nations and her colonies, and the colonies again with other countries and among themselves, it is at least incumbent on those who have calculated the expense of quarantine to state also what may be the probable results of regarding too lightly the advantages of separating the sick and infected from the healthy and intact.²

¹ During long and continued observation in various climates, from all that I have witnessed and read on the subject, I cannot but be of opinion *that all fevers are essentially the same*, character being assigned to them by accident, locality, habit of body, etc."—*Baseome on the Nature and Causes of Yellow Fever*, p. 9.

² Communicability of cholera proved :—

"In 1833, the frigate *Melpomene* arrived at Toulon from Lisbon, at which latter place cholera was raging. The *Melpomene* had lost fifteen men before she started, and more than half the crew had been attacked during the voyage. On her arrival at Toulon, where not a single case of cholera existed, the cholera patients were taken into the lazaretto, where four galley-slave attendants with

If there be no necessity for such a procedure, I am at a loss to understand how such a passage as the following is to be interpreted :—“ A single infected individual may act upon a population zymotically ; that is, as the leaven that sets in action the fermenting mass.” I presume the word fermenting, should be read fermentable, because a fermenting mass is already in a state of activity, and therefore requires no leaven to set it in action. Without paying any special regard to this little oversight, and taking the fact intended to be conveyed, who can say what are the actual circumstances and conditions under which any infected person may become a source of contamination ? Has that epidemic influence ever been defined, which determines, or is said to determine, the communicability of a disease ? This “ influence ” is also said to have grades of intensity. Now it seems to me that when this “ influence ” has shown itself so strongly, as it appears to have done sometimes on ship-board, we might have acquired from those who witnessed its effects, some more specific information than the mere notice, under an ambiguous phrase, of the energetic operation of some peculiar contaminating principle, deriving its activity from an unknown and indescribable force. The only epidemiometers are the records of death or disease ; then why are we to assume the existence of a new force that can be brought under no tests but such as are furnished by these documents ? We might as well talk of a fruit influence, or force, when fruit abounds—of a locust force, or a fly force, when these insects are more than usually abundant. The advocates of the “ epidemic influence ” and malarious origin of epidemic diseases, find some difficulty in explaining how it is that ships, before reaching land, have sometimes become foci of disease. In one instance, yellow fever broke out in a ship far away from land, and this is cited as an undeniable case of spontaneous generation of the disease.¹ Some green wood in the hold was supposed to be the cause of the calamity. When ships’ crews contract the disease on nearing the shore, then land breezes are said to carry the contaminating matter. Now, if

an inspector were sent to wait on them. Four ordinary attendants were also sent on board the frigate. One of the latter was immediately attacked, and died in eight hours. On the next day, two others, who likewise died. The fourth was also attacked, but escaped. Of the four galley-slaves in the lazaretto, two died on the second day, a third soon afterwards, and the inspector on the fifth. The disease did not spread beyond the precincts of the lazaretto, and Toulon remained free from it for two years.”—*Med. Times*, vol. iii. (New Series), p. 515.

¹ An elaborate article, extending into two numbers of the British and Foreign Medico-Chirurgical Review, contains a most impartial statement of the *pro* and *con* “ On the Contagion of Yellow Fever.” The writer emphatically says, “ The case of the ‘ Eclair ’ steamer has thrown a most important light on the subject, and *it will be impossible henceforth ever again to doubt the possibility of a yellow fever being propagated by contagion.*” Referring to Dr M^WWilliam’s Report, he concludes in these words, “ We cannot but believe that as strong a proof of propagation of a disease, from individual to individual, has been made out as can be found in the whole history of contagion.”

land breezes can convey a poisonous agent to a ship, may not sea breezes carry similar agents to the land? It seems to me there must be a very peculiar elective property in these land breezes, which carry a poison over so many heads on shore, leaving them intact, while it selects a comparatively small spot on the ocean for its special activity.

There is a little fact connected with bedding and wearing apparel, of rather more importance than green wood or land breezes, in the solution of outbreaks of disease on board of ships. There is not much clothes washing on ship-board, now perhaps the idea has never entered into the heads of some people, of the probable amount of accumulated human effluvia there may be pent up in the wearing apparel, bedding, etc., in ships. The following table, from some experiments made at the model-baths and wash-houses in Goulston Square, Whitechapel, may furnish an approximated notion :—

Description of Goods.	Weight before being Washed.		Weight when taken from Drying Chamber.		Difference.	
	lbs.	oz.	lbs.	oz.	lbs.	oz.
12 Towels,	7	11	6	12	0	15
Do. ...	7	13½	6	14½	0	15
Do. ...	7	15	6	15½	0	15½
3 Fine Sheets,	4	15½	4	3½	0	12
3 Middling do.,	5	4	4	12	0	8
3 Coarse do.,	7	8	6	15½	0	8½
3 Small Blankets,	6	15	6	3	0	12
3 Do. do.,	6	10	6	0	0	10
3 Large do.,	9	1	8	12	0	5
Total, ...	63	13	57	8	6	5

It is a very fertile source of error, in a sanitary point of view, to exclude infectious diseases from due consideration in regard to quarantine. The whole question of isolation of the sick from the healthy should in reality rest on the fact, that diseases are communicable from one individual to another by human intercourse, and by other sources of infection; for, in the language of the Board of Health, "There are conditions, as those of filth and overcrowding, which, in all climates, and at all seasons, are capable of changing mild into malignant fever, and of causing a form of fever, which under ordinary circumstances is not communicable, to spread like a pestilence." If such can happen, how incumbent must it be on our part to weigh, with the most earnest care, all that is connected with the spread of disease. Because the term contagion, has in olden time excited absurd alarms, and unnecessarily restricted the intercourse of nations, there is no reason why we should rush upon the other extreme, and, with a judicious free trade in commerce, encourage also a free trade in death. Pestilences have their times and seasons: founded on these, well-ordered laws may give us a

minimum of inconvenience, with a maximum of advantage, not hitherto attained.¹

In a social point of view, many are the evils arising from the diversity of opinion among medical men. For how long a time may a person, after having suffered from a communicable disease, transmit it to another? Is a disease contagious or infectious, or is it not? and many other questions of a like nature. These are answered not according to any fixed rules, but quite arbitrarily, so that *tot homines tot sententiæ*, applied to us, is not an unmerited opprobrium.

It is highly necessary, too, that we should be guarded in giving an unqualified opinion as to the infectiousness of any disease where doubts exist. In this country it is supposed that croup is not communicable; but that it is so, is unquestionable. A melancholy example, arising from prejudice on this head, has been narrated of a physician who recently arrived in Sweden; to prove the correctness of his views, that croup is not infectious, in opposition to those there entertained, he placed his own son, a boy of three years old, in the same bed with a child affected with croup, but on the following day, the previously healthy child was affected with the disease and died, in spite of all the efforts of the distressed father, who himself, horrified at the unlooked-for results of his experiment, soon followed his son to the grave.² It is imperative that this Society should lay down some general principles as a basis for inquiry concerning "contagion." No opportunity like the present has ever occurred, when, voluntarily, men have united together with a determination to sift thoroughly the phenomena, and accumulate the facts, connected with epidemic and infectious disease. The time has come when we must cease to hear of cholera and yellow fever being "contingently contagious," that at one time they are contagious diseases, and at another not. They are either contagious or infectious diseases, or neither; there is no middle state. If a disease ever exhibits infectious properties, it is in every sense of

¹ An article in the Edinburgh Review of the current quarter, makes very short work of the quarantine question. Its important bearings, as a sanitary measure, are made to give place to commercial convenience, and that which demands the most searching medical inquiry, is dismissed as an ordinary matter of evidence,—the whole subject being argued upon grounds which have led an indefatigable medical analyst to conclusions diametrically opposed to the Edinburgh essayist. Whatever may be said to the contrary, it is undeniable that there is a *yellow fever* which is communicable from one person to another. The whole matter, therefore, rests upon a purely medical investigation, viz., the place and relations of this form of fever in relation to other fevers of hot climates.

² The instance above cited, would of itself be no proof that croup is communicable. The fact, however, rests upon abundant evidence, according to the Swedish physicians. In France also the same opinion obtains. M. Bretonneau directed attention to its association with epidemic diphtherite; and M. Trousseau has subsequently confirmed this observation, as well as substantiating the infectious character of the disease.—*Gazette des Hôpitaux*.

the words, an infectious disease, and should invariably be considered as such. Nothing is more pernicious than that unhappy system of trifling with words. The absence or presence of certain extraneous conditions have no essential connection with a disease; a magnet is as much magnetic without the presence of the armature as with it, though it may not give evidence of its properties; the power is there, though not manifest; and so is the power of contamination in an infectious disease, though that power may not be developed. Herein and in such matters our business lies; to root out all errors from our nomenclature, and to scatter all sophistry to the winds. As a conclusion to these observations, allow me to draw your attention to a circumstance of recent occurrence, which most emphatically points out to us a work to be done, and which would be without any remarks from me, sufficiently suggestive of the urgent need there is for a speedy settlement of the controversy which has its origin in the indeterminate expressions, contagion and infection. In a bill lately brought before Parliament for the better management of hackney carriages and cabs, a clause was introduced to place restrictions on the conveyance of persons in public carriages who have recently suffered or are suffering under any infectious disease. On the reading of this clause in the House of Lords, "Lord Campbell, as one of her Majesty's judges, begged to observe, that if they passed the clause it would be difficult to find out what were infectious diseases. If the question were to come before the judges, he suspected that seven of them might be found on one side and eight on the other. Some people said there was no such thing as infectious diseases. How was it intended the question should be decided? Was it to be decided by a jury, or how?"

If I have failed in argument to arrest attention on this subject, I trust the simple record of the above statement is a sufficient plea for bringing the question of contagion and infection in so special a manner under the consideration of this Society. If, again, in the opinion of some I have ventured too far into the regions of hypothesis, I fall back on the intricacy of the subject as my excuse, and seek to palliate my fault under the following quotation from Professor Whewell's *History of the Inductive Sciences*, wherein he recommends us to struggle with our ignorance, or imperfect knowledge, in these words:—"We must strive to refer facts which are known and understood to higher principles, of which we cannot doubt the existence, and of which in some degree we can see the place, however dim and shadowy may be the glimpses we have hitherto been able to obtain of their forms. We may often fail in such attempts, but without the attempt we can never succeed."

